

receiving the electrode in the outer shaped portion of the plurality of cooling holes; and
removing the nonoriginal coating from the outer shaped portion using electrical discharge machining such that the outer shaped portion meets the predetermined air flow requirement.--

Kindly amend claim 2 as follows in re-written "clean" form:

--Claim 2. (Amended/Marked Up) The method of claim 1 further comprising:

propelling a stream of abrasive particles into the inner metering portion of the plurality of cooling holes to remove the nonoriginal coating from the inner metering portions of the plurality of cooling holes.--

Kindly amend claim 3 as follows in re-written "clean" form:

--Claim 3. (Amended/Marked Up) The method of claim 1, wherein the article further includes a second plurality of cooling holes having a predetermined air flow requirement, the method further comprising:

filling the second plurality of cooling holes with a repair material prior to the recoating step; and

remanufacturing the cooling holes filled with the repair material to meet the predetermined air flow requirement of the second plurality of cooling holes using electrical discharge machining.--

REMARKS

Claims 1-8 are pending in the present application and presently stand rejected. Claims 1-3 have been amended. Claims 2-7 ultimately depend from amended claim 1. Claim 3 has been amended to more clearly define the predetermined air flow requirement being that of the *second* plurality of cooling holes.

Support for these amendments can be found in the original specification. No new matter has been introduced.

1. Claim Rejections Under 35 USC 112

Claims 1-8 are rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In particular, in claim 1 no connection has been made between the electrode and how the restoration takes place. In claim 2 there is no proper antecedent for the repair material and the claim depends from itself.

Applicants have amended claim 1 to distinctly claim the connection between the electrode and the restoration step. [specification, paragraphs 55, 59, 60, page 15, 16, respectively].

Applicants have amended claim 2 to depend from claim 1 thereby 1) correcting the dependency and 2) replacing 'the repair material' with 'the nonoriginal coating'. Support for this change is found in the specification, paragraph 64, page 17.

All amendments have been made consistent with the specification. No new matter has been added. With the above changes and their respective comments, reconsideration of this rejection is respectfully requested.

Claims 3-8 ultimately depend from amended claim 1 and are therefore definite.

1. Claim Rejections Under 35 USC 102(b)

Claims 1-2 and Claim 10 are rejected under 35 USC 102(b) as being anticipated by either one of Biederman et al., Boley or Moore, Jr. et al.

Claims 1 and 10 have been amended to more clearly define the structure of the device claimed. The Examiner's rejections under 35 USC 102(b) are hereinafter traversed and reconsideration is respectfully requested for the following reasons.

Applicants' respectfully submit that the present invention is patentably distinct from that the art cited in page 3, line 7 through page 5, line 26 and in particular US patent 4,008,844, Duvall et al., of common assignee herewith.

Patent 4,008,844, Duvall et al., teaches 1) filler powder or *alloy compositions* for filling voids in or between metallic articles and 2) the preferable *heat treatment steps* used in conjunction with the alloy compositions developed to maximize the benefits achievable with the alloy compositions. It is further noted that in the prior art, the repair of an article, such as an airfoil, requires that all the cooling holes be completely filled in the airfoil. This filling process is both labor intensive and costly and will necessitate the

expensive operation of remanufacturing the cooling holes which can number in the hundreds for a typical airfoil.

The reference made in Applicants' specification [page 3, line 7 through page 5, line 26] is made to provide *a repair material or alloy composition* suitable for use with the inventive repair method.

Applicants' will now detail how Applicants' invention is patentably distinct over the cited prior art.

The present invention describes a repair method for an article having cooling holes and in particular, shaped cooling holes or diffusion cooling holes 18. The holes 18 have a diffuser passage 52 and a metering passage 60 [Please see Fig. 4]. The cooling holes and, in particular the diffusion cooling holes 18, must be repaired in an airfoil before reentering service. This repair is expensive in time, labor and cost. The present invention employs different electrodes 56, 62 to different regions 48, 50, respectively, of the article *based on the degradation experienced in the regions 48, 50*. In this way and, unlike the prior art methods, the present invention takes advantage of discrete local regions 48, 50 of the article that are in various states of degradation. Specifically, the invention permits a cost, labor and time repair method that permits the 1) removal of the entire coating system and subsequent recoating of the article as well as 2) the selective repair of defects. This method is very advantageous over the prior art methods as will be detailed below.

The prior art repairs of defects include filling all the cooling holes of an airfoil with a repair material. This is timely and expensive and involves the remanufacturing of all the cooling holes – even if all the holes did not require the repair – ie. to be filled with the repair material. Further, if the cooling hole being remanufactured is a diffusion hole 18, and thus having a diffuser passage 52 and a metering passage 60, this becomes an expensive manufacturing step.

In the present invention, the holes 18 of the airfoil are not all filled with a repair material. Rather, the repair material is selectively applied to those cooling holes 18 that do not meet predetermined inspection repair criteria. As provided for in Applicants' specification, the holes 18 that do not meet the inspection criteria are in region 48. An electrode 56 [Fig. 6] is utilized to remanufacture those cooling holes targeted for repair.

Thus, the selective application of the repair material is advantageous as it saves labor and time since only those cooling holes where a repair is required are effected. With electrode 56, both the diffuser passage 52 and the metering passage 60 of the diffusion holes 18 are reproduced as per the original diffusion hole prior to the repair thus restoring the predetermined air flow requirement.

In the present invention and as described above, the diffusion holes 18 in region 50, however, are not subjected to being filled by repair material since these holes do not require the repair. Therefore, in the present invention, there is no need to perform the expensive remanufacturing step that is required for the holes in region 48. Yet, these holes 18 in region 50 are subject to coat down and therefore are required to be reworked before the article can enter service. Coatdown refers to the excess coating that can accumulate in the mouth of each hole 18 is due to the application of the non-original coating to the article. It is often the case that the mouth portion or diffusion passage 52 of the holes 18 in region 50 are clogged due to the coat down. The metering passage 60 [para. 63, page 17] is not effected. Thus, the present invention in claim 1 recites, in part, the steps of:

providing an electrode for electrical discharge machining; wherein the electrode *having only a shaped portion with a preselected shape;*
receiving the electrode in the outer shaped portion of the plurality of cooling holes.

This is accomplished with the use of an electrode 62 which is adapted specifically to restore the flow requirements of the diffusion passage 52 only. This step removes the excess bond coat material that has been applied to the article. Thus, for the diffusion holes 18 in region 50, the holes 18 are reworked. The step of having to remanufacture the metering passage 60 of the holes 18 in *region 50* has been eliminated. This is another advantage of the present invention over the prior art. The elimination of this step significantly contributes to the reduction of manufacturing costs and time which is critical in a manufacturing environment. Thus, the selective application of the repair material to the holes in region 48 is not only advantageous to the repair for region 48 but is also advantageous to the repair of the holes 18 in region 50. This feature is recited in

amended claim 3. Still further advantage of the present invention is that the reworking of the holes 18 in region 50 is done on and as needed basis and electrode 62 provides the benefits of EDM and saves the additional expense of drilling the metering passage 60. For instance, if the holes in 18 region 50 were filled with the repair material, as in the prior art, then the metering passage 60 may be clogged and would need to be remanufactured. Finally, if there should be any coat down in the metering passage 60 of the holes 18 in region 50, a stream of abrasive particles can be propelled into the diffusion passage 52 of each affected hole 18 [amended claim 2]. Again, no costly and timely drilling operation would be required to the holes in region 50.

In short, the present invention provides a method for reworking cooling holes subject to coat down only using an electrode having only an outer shaped portion to restore the diffuser passage 52. The manufacturing steps for the metering passages 60 are thus not done as being unnecessary. Further, the present invention provides that only those cooling holes that do not meet predetermined inspection criteria are a) filled with a repair material and b) subsequently remanufactured.

Applicants' respectfully submit that the prior art made of record including Duvall et al. does not teach or suggest Applicants' method of repair and respectfully submit that amended claim 1 patentably distinguishes over the prior art of record. With the above remarks in mind, the Applicants respectfully submit that amended claim 1 defines over the prior art and allowance is respectfully requested. Claims 2-8 are ultimately depended from claim 1 and are therefore patentable over the prior art of record for at least the reasons cited above with respect to claim 1. Reconsideration of this rejection is respectfully requested.

Summary

After careful consideration of the Examiner's Office Action, the present application has been amended to overcome all of the rejections. In light of Applicants' amendments and accompanying remarks, it is respectfully submitted that all of the pending claims 1-8 are allowable over the applied references as well as the prior art made of record. Allowance of claims 1-8 is respectfully requested.

Applicants respectfully submit that this amendment introduces no new issues which have not been previously been considered and is appropriate for entry. No new matter has been added. Accordingly, Applicants respectfully request reconsideration of the reference application and entry of this amendment.

The Examiner is cordially invited to contact the undersigned by telephone to expedite any further issues or concerns.

Applicants enclose a petition for a three-month extension of time under 37 CFR 1.136(a) to respond to the Office Action. Please charge the fee for this extension of time and any additional charges with respect to this Amendment or otherwise, to Deposit Account No. 21-0279, Docket Number EH-10485.

Respectfully submitted,

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EXHIBIT A - VERSION WITH MARKINGS TO SHOW CHANGES MADE.

A 'marked up' version of claim 1 follows:

--1. (Amended/Marked Up) A method for repairing defects in an article, the article comprising a substrate and an existing coating on a surface of the substrate, the article including a first plurality of cooling holes extending from the substrate and the existing coating and having a predetermined air flow requirement, the plurality of cooling holes having an outer shaped portion and an inner metering portion, the method comprising:

removing the existing coating;

recoating the surface of the article with a nonoriginal coating;

providing an electrode for electrical discharge machining; wherein the electrode having only a shaped portion with a preselected shape;

receiving [an] the electrode [having only a shaped portion with a preselected shape] in the outer shaped portion of the plurality of cooling holes; and

[restoring the outer shaped portion of the plurality of cooling holes to meet the predetermined air flow requirement]

removing the nonoriginal coating from the outer shaped portion using electrical discharge machining such that the outer shaped portion meets the predetermined air flow requirement.--

--Claim 2. (Amended/Marked Up) The method of claim 1 [2] further comprising:

propelling a stream of abrasive particles into the inner metering portion of the plurality of cooling holes to remove the [repair material] nonoriginal coating from the inner metering portions of the plurality of cooling holes.--

--Claim 3. (Amended/Marked Up) The method of claim 1, wherein the article further includes a second plurality of cooling holes having a predetermined air flow requirement, the method further comprising:

filling the second plurality of cooling holes with a repair material prior to the recoating step; and

remanufacturing the cooling holes filled with the repair material to meet the predetermined air flow requirement of the second plurality of cooling holes using electrical discharge machining.--